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Homo Oeconomicus in Ancient Athens: Silver Bonanza and the Choice to Build a Navy

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Abstract: In 483/2 BC the ancient Athenians voted to spend the revenue from recently discovered silver deposits to build a navy instead of distributing it as cash transfers to all citizens. The navy was pivotal for victory against the invading Persians and secured the power and wealth of classical Athens. The paper discusses three interrelated issues. (1) The use of the voting mechanism to decide the disposal of the revenue from natural resources. (2) The binary nature of the choice, either transfers or defence but not a combination of the two. (3) An explanation of the vote based on the increase in probability of military victory following an increase in defence spending.

JEL Codes: D7, H4, N4, Q33.

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1. Introduction

In 483/2 BC, the ancient Athenians struck an unusually rich silver vein in Southern Attica. One proposal for the disposal of the revenue from the windfall was to distribute it equally among the thirty thousand citizens, thought to be a common practice at the time,¹ and pay each recipient ten

¹ Gabrielsen, 1994: 235, n.27

drachmas when a labourer's wage was one drachma a day.² However, a second proposal, made by Themistocles, one of the leading statesmen of the time, was to spend the money on the construction of a large navy. One hundred triremes were to be built for use against the island of Aegina competing against Athens for supremacy in the Aegean Sea and an additional one hundred talents were to be deposited with the hundred richest Athenian citizens, each one receiving one talent, for future related use.

The assembly voted in favour of the Themistocles proposal that became known as the "Naval Bill". Following additional shipbuilding, the number of Athenian ships increased to two hundreds, counting for two thirds of the total Greek fleet that in 480 vanquished the Persians in the sea battle of Salamis, and again in Mycale in 479. The 482 vote was pivotal for Athens and even for the modern Western democracies the intellectual heirs of ancient Greece. Not only guaranteed her survival as an independent political entity, but also established Athens as a leading power, precipitating further democratic reforms, economic prosperity and unprecedented artistic achievements.³ Using the insights of modern political economy, the present paper inquires three aspects of the crucial vote of 482, namely, the use of the voting mechanism to decide the disposal of the revenue from natural resources, the binary nature of the choice to pay a transfer or build ships but not a combination of the two, and the outcome of the vote in favour of defence rather than a cash transfer.

In the first instance, it bears noting that it was the Athenian assembly of citizens which decided directly on the use of public revenue, rather than the political elite or the representatives of the voters, a procedure that had no equal in ancient or modern polities (at least at the national scale). More significantly, the majority voted for spending the extra revenue on defence rather than a cash transfer. Standard economic theory predicts that in general individuals motivated by self-interest are better off with a cash-benefit rather than a benefit-in-kind of an equal value, because they are free to spend the extra resources as they wish, and they would rather divide a given budget between a public good and a transfer than spend the entire revenue on either of the two only. Were the Athenians or at least the majority of the citizens overwhelmed by notions of patriotic duty that

² With a number of citizens estimated at 30,000 this implies that the total revenue was 50 talents, where 1 talent = 6,000 drachmas. Finer (1999) reports that a family of four could live off 280 drachmae a year.

³ See Morris (2008, 2010).

made them oblivious to their financial self-interests, or were their interests better served by strengthening the defence of the polis?

The paper is structured as follows. Section 2 reviews the shipbuilding programme. Section 3 surveys issues regarding the use of democratic procedures to decide public spending programmes and the natural resource curse where economies rich in resources perform poorly. Section 4 examines the binary nature of the Athenian choice, transfer or defence only, and offers an account of instrumental versus expressive voting. Section 5 searches for an explanation of the vote in favour of defence using the insights of the economic theory of conflict. Confronted with the uncertain outcome of conflict, it was rational for the Athenians to boost their military capabilities in order to increase the probability of victory against their adversaries. Employing a formal model of expected utility maximization and game interactions it is found that investing the silver windfall in defence yielded a higher expected payoff than a transfer. Thus, in an *ex ante* sense, the Athenians were better off increasing defence spending. Section 6 concludes.

2. The shipbuilding programme

By the time of the discovery of the silver deposits, 483/2, Athens was already operating direct democracy after the Cleisthenes reforms of 508 BC that laid down rules for citizenship and participatory governance.⁴ Decisions on domestic and foreign policy issues were made by the Assembly of all Athenian male citizens by majority voting. Assembly businesses were coordinated by the Council of Five Hundred, a body of citizens selected by lot for an annual term of service. Public officials, like the elected Ten Generals responsible for foreign policy and commanding the army, as well as any citizen could initiate legislation by bringing an issue to the attention of the Council which after deliberation would introduce the issue to the Assembly, either for ratification of specific decree already passed by the Council, or as an open issue to be discussed and voted by the Assembly. It was a standard practice for an individual citizen who so chose to speak during the Assembly. The Cleisthenes reforms had also established a national army of heavy infantry (hoplites) whose ranks were filled by the propertied classes that paid for and owned

⁴ The original record is found in the *Athenian Constitution* of Aristotle. Ober (1996) Ch. 4 offers a reconstruction and an interpretation of the events leading up to the Cleisthenes reforms, while Hansen (1999) amongst others presents a detailed analysis of the nature of the Athenian democracy, 508 – 322. See also Tridimas (2011a) for a political economy account of her governance institutions.

their armoury, but excluded the poor class of *thetes*, who did not afford the expense and served only as light-armed troops. The hoplites army showed its worth first in defending Athens against other Greek city-states and, more importantly in defeating the invading Persians in the 490 battle of Marathon.

In the 480s Athenian politics were dominated by the rivalry between Themistocles who advocated the policy of turning Athens into a sea power, and Aristides, who seemingly opposed it. It is a matter of great regret that the original ancient authors, Herodotus in his *Histories* of the Persian wars, Thucydides in the *History* of the Peloponnesian War, Aristotle in the *Athenian Constitution* and Plutarch in his *life of Themistocles* give only terse and somehow contradictory accounts of the events surrounding the discovery of the silver veins and the use of the expected revenue.⁵ We may surmise that following the practice of the time the Assembly was asked to approve the distribution of the bonanza to the citizens but Themistocles counter-proposed to use the money to build ships. The details of the debate are not known. What is known is that in Assembly debates, after listening to the speakers, the Athenians voted by show of hands and decisions were taken by simple majority. Hansen (1999: 147) describes the voting process as one where “the voting was administered by nine “chairmen.” They first called for the “ayes” to raise their hands and then the “noes.” We have very little evidence how the estimation was carried out... Aristotle’s *Athenian Constitution* implies that the chairmen assessed rather than counted the majority of votes and the same is also implied by Aristophanes. In case of doubt the show of hands was repeated.”⁶

Themistocles won the argument having Aristides ostracised, but we know nothing of the speeches made in the Assembly, the size of the majority for the shipbuilding programme, how it related to Aristides’ ostracism and the exact date of the latter. Ostracism, introduced by Cleisthenes, was a mechanism by which the demos decided whether or not to banish a leading individual, allegedly as a defense of the demos against potential tyrants.⁷ However, Cartledge (2006) argues that Aristides was

⁵ The English translations of the original passages are reproduced in the Appendix. Wallinga (1993, chapter 6) offers a critical survey of the sources and of the views expressed by modern historians.

⁶ Two important exceptions to voting by hand were decisions on ostracism and grants of citizenship which were conducted by actual ballot voting.

⁷ The person ostracized had to leave Athens in ten days after the vote and reside away from the city, but suffered no financial or any other punishment. For a thorough analysis see Forsdyke (2000). It is worth noting that, in the interest of unity against Persia and with the consent of Themistocles, Aristides returned

ostracized not because he was a threat to democracy, but to circumvent impassions about highly divisive issues of policy and leadership. That is, from the viewpoint of modern collective choice theory, ostracism generated a “structure induced equilibrium.”⁸

Focusing on the discovery of the silver deposits and the shipbuilding programme, modern historians have inquired whether the windfall financed the construction of one hundred ships (Aristotle and Plutarch) or two hundred ships (Herodotus), the cost of construction per ship and the annual crew cost, how many of those ships were built in Athens and how many were bought from other city-states; the finance of the running costs of the fleet and especially whether it started a liturgy⁹ known as *trierarchy* (trireme-leadership), according to which the wealthiest Athenians were responsible to pay for the command, outfitting and maintenance of a trireme for one year; and whether the silver vein was struck in Laurium or Maroneia (both located in Southern Attica). For a review and re-examination of the evidence see Gabrielsen (1994). The trireme, a vessel of three rows of oarsmen on each side with a total of two hundred rowers supplemented with two sails was an offensive naval weapon able to attain high speeds under oars; its radius was however restricted by carrying limited food and water supplies, which made its use dependent on a network of coastal bases. It was very expensive to build, and even more so to maintain and pay for crew. Gabrielsen (1994) estimates that the average cost for feeding the crew for a month was half a talent (p.122), and crew pay was another talent for a month (p.124). Wallinga (1993) establishes that Themistocles’ law called for 100 ships to be built (a number matching the strength of Athens’ Greek adversaries). He then argues that Themistocles proposed to entrust the money to private citizens rather than state officials in order to avoid the temptation that politicians would use it for other purposes. In modern parlance, the latter arrangement aimed to enhance the credibility of the warships programme. Further, Wallinga

before the end of the 10 year period shortly before the Battle of Salamis.

⁸ See Shepsle and Weingast (2012) for a recent review of voting cycles and their elimination under different institutional settings.

⁹ Liturgies were compulsory private payments by the richest Athenians for public services. They were a mechanism for public provision circumventing both taxation and public procurement. They probably started with the Cleisthenes reforms. Liturgies before Themistocles’ naval law included the finance of theatrical productions, athletic training and the organization of public religious feasts. See Davies (1967) for a description of liturgies and Lyttkens (1997) for an examination of the liturgies in the light of the rational actor model. For an economic analysis of the triarchy using the insights of mechanism design theory for the provision of public goods see Carmichael (1997) and Kaiser (2007).

argues that in assessing the desired strength of the new fleet Themistocles must have taken account not only of the strength of Aegina but of her potential Greek allies too, calculated at 99 ships (Wallinga, 1993:155), while the Persians were not thought as an immediate threat. When the Athenians found out that the Persians were amassing a fleet of some 1,200 triremes (Wallinga, 1993: p.161) for another invasion to Greece, they must have used (part of) the reserve of 100 talents deposited with the richest Athenians with the purpose to pay for the crews for building an additional 100 triremes, to arrive at the total of 200 which was the size of the Athenian fleet in the battle of Salamis.

Themistocles' shipbuilding programme offered important employment benefits to the poorer class of Athenian citizens, first in ship and harbour construction and auxiliary services and then as paid oarsmen. In addition to the employment gains, the Naval Bill generated positive external effects by boosting production activities in carpentry (ships were made of wood) and metallurgy (ship rams were made of iron or bronze), other support activities and trades, and diffusion of skills. (See Kyriazis and Zouboulakis (2004) for details.) More importantly, the increased economic activity changed the status of the poorer classes of Athenians: Property ownership, military rank and political office were tightly connected. With the Cleisthenes reforms, the poorer Athenians had acquired the right to participate and vote in the assembly but not the right to occupy office. As naval campaigns lasted considerably longer than land campaigns and required large and well-trained crews, the economic and political status of the lower class Athenians manning the fleet changed fundamentally. They were gradually granted access to all political privileges enjoyed by the wealthier classes of landowners. Moreover, "Their paid employment by the state as rowers on the fleet had already introduced compensation into military service...This must have facilitated the introduction of pay for political service," (Raaflub, 2007: 122), which was one of the hallmarks of the Athenian democracy.

3. Political institutions and the natural resource curse

Themistocles law and its far reaching consequences serve as an early case of the nexus between political institutions and economic performance emphasised by modern economic theory; see Acemoglu et al. (2005) and Acemoglu and Robinson (2012). In its simplest form the argument is that political absolutism which concentrates power in the hands of an (unelected) elite leads to extractive economic institutions, which offer little, if any, protection to private property from expropriation, and aim to extract resources from the majority of the population. These effects eliminate incentives for entrepreneurship, innovation and investment

leading to economic stagnation. On the contrary, political pluralism which spreads political power across a wide range of actors fosters inclusive economic institutions that secure property rights and distribute economic power and access to the market widely; this in turn promotes economic prosperity for all (albeit with unequal shares). The Athenian shipbuilding programme was the result of the interaction between pre-existing political institutions that provided for citizen participation in the assembly and the chance event of the discovery of the silver deposit. Kyriazis and Zouboulakis (2004) consider the discovery of the silver vein as the sort of chance event that played an important role in shaping Athens' subsequent development. It precipitated a break with the past, where the great majority of Athenians lived off agriculture, and a turn to the sea to exploit the new military technology represented by the trireme.

It is instructive to contrast the 5th century BC Athenian experience of the silver windfall with that of Spain two thousand years later after her conquest of the Americas. From the unification of the crowns of Ferdinand of Aragon and Isabella of Castile (married in 1469), the Spanish kings ruled as absolute monarchs with few independent political controls over their actions. In the 16th century the Spanish conquistadors who took over the lands of Latin and South America set up authoritarian and hierarchical political structures combined with extractive economic institutions in Mexico and Peru, whose aim was to take silver and gold back to Spain and secure revenues for the crown. As a result, the populations of mainland Spain and the colonies were denied political and economic rights, while the crown and the associated nobility were the only beneficiaries of the new resources and economic opportunities. By stifling private enterprise, over time, this led to the impoverishment of Spain. On the other hand, the democratic structures prevailing in early 5th century Athens allowed a wider sharing of the silver bonanza which in the first instance made possible the survival of Athens as an independent political entity, while in the longer run it underwrote its rise.

The Athenian experience also illustrates how democratic institutions may prevent the "resource curse" where countries rich in natural resources, like oil and precious metals, perhaps counter-intuitively, are suffering from low rates of economic growth and are often ravaged by civil wars. A purely economic explanation of the low income growth is that resource abundance increases wealth inflating demand and prices of non-tradable goods, crowds out productive investment in manufacturing and education driving down exports and the rate of growth more generally. (See, for example, Sachs and Warner (2001).) However, another branch of literature attributes the resource curse to weak political institutions resulting in poor governance, weak rule of law and high corruption. Resource abundance creates significant economic rents enjoyed by the

elites in power which then resist challenges to their position by groups excluded from such benefits and the introduction of innovative technologies that undermine their source of wealth (Auty, 2001; Robinson et al. 2006). That is, an oligarchy finds easier to enrich themselves by owning and exploiting natural resources than creating wealth. This way, they may use the rents from natural wealth to reduce taxes avoiding electoral accountability, buy out opposition groups reducing political competition, and, by spending on the security apparatus, suppress demand for political change. However, this behaviour generates the incentive for rival rent seekers to challenge the ownership of the resources (violently more often than not) destabilizing the economy and the political regime, rather than innovate and invest in growth-promoting activities.¹⁰ On the contrary, a democratic polity, like Athens, that established inclusive institutions and distributed widely the revenue from mineral wealth led to political stability and economic prosperity, as well as military success.

The interplay between natural resources and the institutions set up to exploit them was emphasised in the work of Fleck and Hansen (2006), who present a formal model of the emergence of democracy in Athens. The relatively infertile soil of Attica was better suited for growing olive trees whose cultivation required significant investment by landowners but paid off dividends after long gestation periods. The demos of freemen with modest size landholdings would undertake the required investment (which unlike work in wheat plantations was not easily observable by the ruling elite) and be prepared to defend the polis only if they were safe in the knowledge that their property rights were secure. Participatory politics and democratic procedures introduced by Cleisthenes were the guarantees of those economic rights.

Athenian victory in the sea battle of Salamis depended on the Athenian triremes, which were largely financed by the silver windfall, following the decision of the Athenian electorate to spend the windfall on the oared warships. Clearly at a pivotal time participatory democracy determined public policy with far reaching consequences. Although it is virtually impossible to know the outcome of the Persian wars had the counterfactual of not building the navy taken place, there is no denying that the link between democracy – assembly vote – public spending worked to the broad benefit of the Athenians.

¹⁰ See Frenkel (2012) for a review of the causes proposed in the literature. Testing the resource curse hypothesis with an international sample Mehlum et al. (2006) find that countries rich in natural resources but weak institutions experience low growth rates. See also Busse and Gröning (2012) for a review of empirical studies and evidence that exports of natural resources lead to higher levels of corruption.

4. Voting and public finances

The second issue raised by the present study is the binary nature of the choice of the Athenians, that is, to spend the silver bonanza either on cash transfers or building the fleet, but not a combination of the two. Since consumers benefit from both, it is reasonable to expect that the windfall would have been allocated between a cash distribution of less than 10 drachmas per head together with the construction of fewer than 100 ships.¹¹ We examine a number of arguments that may account for the all-or-nothing choice, notably, non-convex military technology, agenda setting, ignorance and lack of economic rationality.

In the first instance, the decision might have been dictated by military considerations. The forces amassed by the enemy and/or military technology might have been non-convex, or “lumpy,” that is, trireme-based defence becomes effective only after a minimum number of ships are available for service; otherwise ship formation and battle performance are ineffectual. In other words, military technology dictated that the number of ships cannot be treated as a continuous variable to be adjusted at the margin. However, if that was the case, one would have expected to see the point mentioned in the literature. Moreover, as already described, when the Persian threat became visible the Athenians were able to promptly adjust the size of the fleet, implying a kind of continuity of the use of inputs.

The second explanation for the binary choice may be the agenda setting powers of the officials proposing policy to the assembly.¹² Assuming a standard utility function defined over transfers and defence, where marginal utility is positive but decreasing, and taking into account the budget constraint, *silver revenue* = *cash transfer* + *defence expenditure*, voting is over a single dimension and voter preferences are single-peaked, so that the median voter is decisive. Let U_M be the utility maximizing level of combining defence and transfers preferred by the median voter, and let U_D and U_T denote respectively his utility when the entire budget is spent on defence and on transfers. Moreover, suppose that the median voter is better off when the entire budget is spent on defence rather than transfers, so that by construction, $U_M > U_D > U_T$. If for his own reasons the agenda setter proposes “transfer only” and “defence only,” the latter is established

¹¹ More formally, only under very restrictive assumptions about preferences and the relative values of income and government revenue a zero-level transfer is consistent with consumer utility maximization.

¹² This suggestion for budget determination follows from the Romer and Rosenthal (1979).

as the collective choice equilibrium. That is, the entire revenue is spent on defence as observed in ancient Athens. This account is not very likely. Ancient Athens lacked a professional bureaucracy with agenda setting powers, while any citizen could address the assembly. Thus, in all probability the median voter equilibrium combining transfers and defence would have been called during the assembly deliberations and eventually prevailed.

A third explanation for the binary choice may be ignorance of what exactly was involved in dividing the revenue because of the complexity of the issues. Dividing the funds between a fleet, calculating the cash transfer and balancing the books might have been a complex calculation, too demanding on the Athenians. Given the lack of accounting techniques and other quantitative knowledge at the time, proposing a large round figure, like one hundred ships, might have served as a shortcut for a policy proposal that was easier to understand and cost. This argument however ill-sits with the systematic thought and ingenuity that the Greeks had already shown in various areas of intellect and practical applications, as well as in calculating the projected revenues from the silver mines.

The fourth explanation is to argue that the Athenians were not interested in the higher consumption resulting from distributing the silver windfall as cash transfers, but were only motivated by the pursuit of military glory that would be achieved by building a strong defence. This argument echoes the “primitivist” view of the ancient economy espoused by Finlay (1973) and Millet (1991), which rejects the applicability of instrumental rationality, where each actor is a *homo oeconomicus* maximizing a well-defined utility function subject to the relevant constraints given his information set. In this tradition the ancient economy was primitive, small scale and household-based; individuals pursued the ideal of self-sufficiency at the household and the city-state level, and economic activity was embedded in social and political institutions. It considers the ancient actors as “status-maximizing” motivated chiefly by military honour, and interested in economic variables like consumption or profits only as a way to promote the military and political success of the city-state and their own abilities to play a leading role in it. In terms of a formal utility maximization framework, the pursuit of military victory to the exclusion of financial interests would be modeled by assuming a very restrictive type of preferences that leaves out material attributes.¹³ Yet, the assumptions that the Athenians voted for defence because they had no

¹³ In terms of a formal utility maximization framework, this would be modeled by assuming a very special type of preferences that excluded material attributes. I thank Manfred Holler for bringing this possibility to my attention.

interest in cash is contradicted by the statements in the sources (that Themistocles persuaded the Athenians to build the fleet against the cash distribution of the bonanza) and, in later occasions, when spending public revenues for civilian projects (amongst others, temples and the theatre throughout the 5th and 4th centuries). More generally, the primitivist account is rebuffed by contemporary “modernist” scholars who explain that the Athenian economy was market-driven and characterized by sophisticated institutions for private contracting and market exchanges and it was underpinned by values that encouraged entrepreneurship; see amongst others Burke (1992) and Cohen (1992) and Bitros and Karayiannis (2008).¹⁴ Other scholars adopt more eclectic views. Examining 4th century Athenian investment behaviour Christesen (2003) concludes that the base assumption in ancient history should be reflexive rationality, which posits that actors pursued profit maximization aware of risk and return factors but were sensitive to social norms (specifically, the inherent virtue of agriculture). In his analysis of the institutions of Athens, Lyttkens (2013: 5) assumes that “while individuals try to be rational, they can only be so in a limited way, displaying bounded rationality...and satisficing behaviour.”

Nevertheless, transposing notions of non – instrumental rationality from economics to politics offers new valuable insights to various aspects of political behaviour and especially the motivation to vote. In the standard application of rational choice theory, voters vote instrumentally, that is, they vote for the policy that they *ex ante* expect to leave them better off. The problem with this type of instrumental voting is that it is irrational to vote, since it is costly for a voter to acquire information about policy issues, while he has an infinitesimally small chance that his vote will decide the outcome. On the contrary, voting may be expressive, where a rational voter aware that his vote cannot decide the electoral outcome votes for the utility gained by carrying out what may be considered a civic duty and by expressing support for a policy or a person rather than his self-interest, see Brennan and Hamlin (1998) and (1999) Hamlin and Jennings (2011). Expressive voting may be motivated by a voter’s wish to put across his social identity relative to others and support for particular values and ideologies or political leaders (and indeed project an identity that pleases the individual himself or others but ultimately as noted by Hillman (2010), runs against his own interests). Elements of expressive voting are easily perceptible in Athenian political life. There is a certain element of pleasure derived from the social interaction when attending mass assembly meetings, listening to the public speakers and endorsing or

¹⁴ For details on the pursuit of honour, see Davies (1993) chapter 6, and Cartledge (2009) chapter 2; for a critique of Finley, see Morris (1994).

rejecting political leaders without necessarily expecting to influence the outcome.¹⁵

In the case of the naval bill, an expressive element was likely present since it is possible that the personal appeal of Themistocles swayed the vote.¹⁶ At the same time there are good reasons to believe that instrumental voting offers a good approximation to the Athenian political scene. Participatory politics and assembly deliberation were the hallmarks of the direct democracy. By 482/3 a generation of Athenians (since the Cleisthenes reforms of 508) had lived through and experienced political decision making via sovereign assembly meetings without political parties, where it was in citizen's interest to get informed about what was involved and reveal preferences¹⁷, especially since the same citizens would be called to fight and risk their lives. It bears noting that, as put by Hamlin and Jennings (2011: 650), "expressive and instrumental motivations are best seen as joint inputs into an overall analysis of behaviour, rather than alternative models."

In positive and normative questions where the focus of attention is predicting or determining outcomes, the model of instrumental rationality has proved indispensable. This is the case in the present inquiry, where the model of *homo oeconomicus* provides a rich and suitable framework to examine the choice between cash and defence expenditure. That is to say, when confronted with a range of options, the rational actor chose the one which was likely to confer him the biggest payoff. This is formally investigated in the following section.

5. Conflict and the choice for defence

Kyriazis (2009: 115) argues that the decision of the Athenian assembly to build triremes "...represented a balance between 'altruistic' and 'self-interested' behaviour on behalf of the voters who voted for it... because the voters sacrificed personal consumption in exchange for the public good of defence that they hoped would guarantee for them their way of life, values, religion, etc. It also embodied self-interest because Themistocles promised to the poorer citizens, who would become the

¹⁵ It seems the Athenians were keenly following the assembly debates cheering and booing the speakers (Hansen 1999).

¹⁶ Plutarch 5.4 writes [Themistocles] was on good terms with the common folk, partly because he could call off-hand the name of every citizen, and partly because he rendered the service of a safe and impartial arbitrator in cases of private obligation and settlement out of court.

¹⁷ On the aggregation of information and coordination of collective action, see Ober (2008).

oarsmen of the ships, “full citizens’ rights ... and remuneration for rowing.” Unfortunately this account of the vote is unsatisfactory. As it is shown here, voting for defence is perfectly consistent with the self-interests of both rich and poor, so evoking altruism to explain the vote outcome is not necessary and probably misleading. Nor do employment opportunities for the poor citizens offer a satisfactory argument, because if Themistocles and the majority of citizens were only interested in employment benefits, the money could have been spent on public building projects, like temples.¹⁸ To interpret the shipbuilding programme as an employment project misses the point that the extra revenue was spent to increase Athenian defence capabilities.

A rational actor facing a military threat will spend the resources under his command in the type of contest (land or naval warfare) that brings him the highest expected payoff. A more articulate account of the Athenian vote recognises that choosing to spend the revenue on the triremes increased the probability of successful defence. Drawing on the economics of conflict the present Section explores this issue. The economics of conflict is a branch of literature that applies conventional standard utility maximization notions and game theory techniques to analyse the behaviour of actors when instead of market exchanges they engage in fighting over resources and they face the risk that their assets will be taken away; see Anderton and Carter (2009) for an introductory, book-length, treatment of the topic and Garfinkel and Skaperdas (2007) for a formal survey of the literature. As already described, the Athenians built the fleet to meet the naval challenge from the island of Aegina. The key here is to appreciate that the Athenians realized that they were engaging in a conflict whose outcome was uncertain or rather probabilistic. Building the navy increased substantially the probability of victory. In order to fend off the security and economic threat from Aegina they had to equip appropriately, trading off increased consumption and a possible loss of freedom for the probability to win the military contest.

(i) Athenian payoff under transfer payments

Formally, we consider a setting with two rival players, Athens, *A*, and her opponent, *B*. The latter may denote either Aegina or Persia. Let *Y* denote the size of Athenian resources available for consumption independent of the silver windfall, and let *S* denote the value of the silver windfall. When

¹⁸ Indeed after the end of the Persian wars, Themistocles started the fortification of Athens. The Long Walls and the temple building in the Acropolis were completed in the mid 5th century.

S is used to finance a transfer to the Athenian citizens, the total resources available to the Athenians for consumption purposes is the sum $Y+S$, while if S is used to finance military spending the total available for consumption is Y . However, war results in destruction of a proportion $0 < \theta < 1$ of the available resources, so that the net available resources are $(1-\theta)(Y+S)$. Since in the 480s Athens was fighting an existentialistic war, it is assumed that if the Athenians win the war they keep the available resources, while if they lose the war they are left with *nothing*. That is, we abstract from consideration of the possible war loot that the Athenians can get if they beat their enemy. On the other hand, their aggressor is assumed not to risk any of their domestic wealth, so that if they beat the Athenians they take all the available resources, $(1-\theta)(Y+S)$, while if they are beaten they get *nothing*.

Let the freely chosen expenditures to finance the effort required to fight, weapons and other activities associated with fighting a war by the two sides be W_A and W_B respectively. Following standard practice, the probability P that the Athenians win the war is assumed to depend positively on their defence expenditure, W_A , and negatively on that of B , W_B , according to the contest success function (see Tullock, 1980; Garfinkel and Skaperdas, 2007; Chang et al. 2007; and Tridimas 2011b).

$$P = \frac{\alpha W_A}{\alpha W_A + (1-\alpha)W_B} \quad (1)$$

The probability that the Athenians lose the war is $1-P$. The parameters $0 < \alpha < 1$ and $0 < 1-\alpha < 1$, measure the war effectiveness of A and B respectively. For example, depending on territorial advantage, military planning, organization, morale of the fighting men and other relevant considerations Athens may have a military advantage against her enemy, so that $\alpha > 1/2 > 1-\alpha$. When the two sides are equally effective, then $\alpha = 1-\alpha = 1/2$; if in addition they spend equal sums of resources to fight the civil war, $W_A = W_B$, Athens and her enemy stand an equal probability of success, $P = 1-P = 1/2$. The expected payoffs of Athens when the Athenians use the silver windfall to make a transfer payment to each citizen, and her opponent, are written as follows (where subscript T refers to transfers)

$$U_T^A = P_T (1-\theta)(Y+S) - W_A \quad (2.A)$$

$$U_T^B = (1-P_T)(1-\theta)(Y+S) - W_B \quad (2.B)$$

The Nash equilibrium of the war game is obtained when A maximizes (2.A) with respect to W_A subject to (1) treating W_B as given, and B maximizes (2.B) with respect to W_B subject to (1) treating W_A as given.

Solving we obtain the following equilibrium values of expenditures for fighting and probability that A wins the war (it can easily be checked that the second order conditions for maximization are satisfied)

$$W_{AT}^* = W_{BT}^* = \alpha(1 - \alpha)(1 - \theta)(Y + S) \text{ and } P_D^* = \alpha \quad (3)$$

Clearly, the size of defence expenditure varies proportionately with the size of income at risk, $dW_{AD}^*/dY > 0$. Substituting from (3) into (1) we obtain the expected payoff from using the silver revenue to make a cash transfer to each citizen

$$V_T^A = \alpha^2(1 - \theta)(Y + S) \quad (4)$$

The expected payoff depends positively on the fighting effectiveness, or, equivalently, the equilibrium probability of military victory, the size of the total resources available, and negatively on the losses from war.

(ii) *Athenian payoff under defence*

When the Athenians spend the entire silver windfall to boost military expenditure, the probability of victory is assumed to be

$$P_D = \frac{\gamma(W_A + S)}{\gamma(W_A + S) + (1 - \gamma)W_B} \quad (5)$$

Two new elements are *simultaneously* introduced. In the first instance, with the silver revenue spent on triremes, total military expenditure expands to the sum of $W_A + S$, where W_A is again endogenously determined. Second, and equally important, in order to account for the enhanced military capabilities of the trireme, when the silver bonanza is spent to build the navy, the war effectiveness of Athens becomes γ which is assumed to be greater than without investing in ships, $\gamma > \alpha$, where again $0 < \gamma < 1$. The effectiveness of her enemy is now $1 - \gamma$. Note that $dP_D/dS > 0$ and $dP_D/d\gamma > 0$, that is the probability of victory increases with the sum invested in triremes and the effectiveness of the Athenian defence.

The underlying rationale for expressing the probability of Athenian victory as in equation (5) is as follows. The Athenians realized that if the silver revenue was distributed as cash, it would not be feasible for the citizens to collect the sums needed to build a fleet and reap the benefit of the sea defence; instead they would have to rely on the land forces. They would have been richer by ten drachmas but would have to fight as hoplites and light-armed *thetes*. The reason is that following the

Cleisthenes reforms, personal tax payments had been abolished because they were considered as a form of servitude and unfit for free citizens. However, they also appreciated that if the polis kept the silver revenue instead of returning them as cash transfers, it would be possible to finance the navy. In other words, the polis as a public body was able to direct and coordinate the construction of the navy, so that collectively the Athenians could accomplish what they were not able to achieve individually. This difference reveals a form of non-equivalence of public funds: Money in the hands of the citizens will not be used the same way as the same sum of money in the hands of the polis. The reason is not the presence of an agency relation (where in maximizing their private interests the public officials pursue a course of action different to that preferred by the citizens) or ignorance, but the difficulties that citizens may face to act collectively after they receive the transfer; that is, the citizens individually may not be able to build the expensive triremes.

Assuming further that the positive external effects generated by building and maintaining a fleet increase output by a quantity βS , $0 < \beta < 1$ (as suggested by Kyriazis and Zouboulakis 2004), the expected payoffs of Athens and her opponent are now written as (where subscript D refers to defence)

$$U_D^A = P_D (1-\theta)(Y+\beta S) - W_A \quad (6.A)$$

$$U_D^B = (1-P_D)(1-\theta)(Y+\beta S) - W_B \quad (6.B)$$

Working as before, that is Athens maximizes (6.A) given the reaction of the enemy and the enemy maximizes (6.B) given the reaction of Athens, the equilibrium values of military expenditure and the probability of Athens beating her opponent are given by the expressions

$$\begin{aligned} W_{AD}^* &= \gamma(1-\gamma)(1-\theta)(Y+\beta S) - S; \\ W_{BD}^* &= W_{AD}^* + S; \\ P_D^* &= \gamma \end{aligned} \quad (7)$$

Attention must be drawn to two important implications of the equilibrium expression for W_{AD}^* . First, and as it was the case with equation (3), we obtain that defence expenditure increases with the size of income at risk, $dW_{AD}^*/dY > 0$. This conclusion explains why the Athenians increased the size of the fleet when it became obvious that Persia rather than Aegina was the most dangerous enemy. Competition against Aegina concerned security of the shipping lanes at a time when Athens depended on

imported grain. Conflict against Persia included not only trade but the very existence of Athens as a free entity. An existential threat implies that a far bigger size of Y was at stake against Persian rather Aegina and the size of expenditure to build the navy increased accordingly. The second important observation from (7) is that since by assumption $\gamma > \alpha$, the probability of victory is higher, $P_D^* = \gamma > \alpha = P_T^*$. Substituting from (7) into (6.A) we obtain that the equilibrium Athenian net expected payoff from using the silver revenue to build triremes is

$$V_D^A = \gamma^2(1 - \theta)(Y + \beta S) + S \quad (8)$$

As before, the expected payoff depends positively on the Athenian fighting effectiveness, the size of the total resources available, and negatively on the losses from war.

We can now check whether the Athenians are better off in ex ante sense by using the silver bonanza to pay transfers or build the fleet. Whether the Athenians choose the transfer or the shipbuilding programme depends on which of the two uses of the revenue yields the higher expected utility. Subtracting (4) from (8) we have

$$V_D^A - V_T^A = (\gamma^2 - \alpha^2)(1 - \theta)Y + [1 - (\alpha^2 - \beta\gamma^2)(1 - \theta)]S \quad (9)$$

The first component of the sum in the right-hand-side of (9) represents the advantage from investing the revenue from the silver in triremes, a superior military technology, and is positive since by assumption $\gamma > \alpha$. The second component represents the net value of expected output when the silver windfall is invested in defence, and recalling that $\alpha < 1$ and $\theta < 1$, it is also positive, since $1 > (\alpha^2 - \beta\gamma^2)(1 - \theta)$. That is, we reach the unambiguous conclusion that in an ex ante sense, the Athenians are better off by using the silver windfall to finance their defensive program rather than awarding themselves a higher level of consumption. They therefore choose to build the ships. It bears noting that the same conclusion holds even when $\beta = 0$. That is, the Athenians are better off with defence expenditure even if there are no external effects from building the fleet. More generally, it can easily be confirmed that the difference $V_D^A - V_T^A$ is increasing in the variables of interest γ , β and S and on private resources (income).

Therefore, the model of expected utility maximization under uncertainty and strategic interactions between the contestants accounts for the observed choice of the Athenians without recourse to non-economic arguments. This finding supports emphatically the application of the homo

oeconomicus hypothesis in understanding the pattern of behaviour in ancient Athens.¹⁹

To complete the historical narrative that opened this work it is worth noting that the Athenian investment in triremes also eliminated the threat from Aegina. After the Persian wars Aegina gradually declined and became a member of the Athens-led alliance established after the Salamis victory.

6. Conclusions

The purpose of the present paper has been to examine the economic rationale of the choice of the majority of the Athenians in 483/2 to invest the public revenue accruing from a newly found vein of silver in building a fleet rather than distributing it amongst themselves as a lump-sum payment. The effect of direct democracy and majority voting on the disposal of public funds was first discussed. Since standard public economics reasoning would imply that citizens in a direct democracy would have voted to divide the silver revenue between a cash transfer and defence, a number of arguments for choosing defence-only were reviewed. These related to lumpiness of defence, agenda setting, limited ability to assess the net benefits of the programme and lack of economic rationality. For all of the above sufficiently good counter-arguments were found. The analysis then proposed an explanation based on the economic theory of conflict. Acknowledging that an increase in military expenditure is followed by a commensurate increase in the probability of victory against the enemy, and that the Athenians realized they could invest in building triremes only when they acted collectively but not individually, it was shown that investing the revenue in defence resulted in a larger *ex ante* payoff.

The analysis was grounded on notions of instrumental rationality which has gained considerable traction in recent analysis of ancient economic history. Of course, it only offered a snapshot of the complexity of the conflict between the alliances of the independent city-states of ancient Hellas against Persia. Several questions of interest remain, including an economic analysis of the formation of the alliance to conduct the defensive

¹⁹ Standard expected utility theory offered a strong prediction in favour of defence spending. An anonymous referee pointed out that the prospect theory of Kahneman and Tversky (1989) which emphasises that fear of loss has a stronger impact on an individual's choice than the expectation of a gain, strengthens the case for voting in favour of defence when the Persian threat became apparent. The Athenians were fighting for their survival and freedom while the Persians were fighting for conquest and under command of king Xerxes.

war, its breakup, and the offensive led by Athens against Persia, as well as the changing economic fortune of the silver mines in later years. These are left for future research.

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Appendix: The sources

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The advice of Themistocles had prevailed on a previous occasion. The revenues from the mines at Laurium [1] had brought great wealth into the Athenians' treasury, and when each man was to receive ten drachmae for his share, Themistocles persuaded the Athenians to make no such division but to use the money to build two hundred ships for the war, that is, for the war with Aegina. This was in fact the war the outbreak of which saved Hellas by compelling the Athenians to become seamen. The ships were not used for the purpose for which they were built, but later came to serve Hellas in her need. These ships, then, had been made and were already there for the Athenians' service, and now they had to build yet others. In their debate after the giving of the oracle they accordingly resolved that they would put their trust in the god and meet the foreign invader of Hellas with the whole power of their fleet, ships and men, and with all other Greeks who were so minded.

[1]Silver, lead, and perhaps copper mines in Attica, from which the state drew an annual revenue. Apparently when this exceeded the usual

amount the general public received a largess. Even if the population numbered 30,000 (cp. Hdt. 5.97) ten drachmae per head would be only 50 talents; far too small a sum for the building of 200 ships; Herodotus cannot mean more than that the Laurium money was a contribution towards a ship-building fund.

Thucydides. History of the Peloponnesian War, [1.14.1–2], B. Jowett (ed.)

These were the most powerful navies, and even these, which came into existence many generations after the Trojan War, appear to have consisted chiefly of fifty-oared vessels and galleys of war, as in the days of Troy; as yet triremes were not common. But a little before the Persian War and the death of Darius [485], who succeeded Cambyses, the Sicilian tyrants and the Corcyraeans had them in considerable numbers. No other maritime powers of any consequence arose in Hellas before the expedition of Xerxes. The Aeginetans, Athenians, and a few more had small fleets, and these mostly consisted of fifty-oared vessels. Even the ships which the Athenians built quite recently at the instigation of Themistocles, when they were at war with the Aeginetans and in expectation of the Barbarian [Persians], even these ships with which they fought at Salamis were not completely decked.

Aristotle. The Athenian Constitution [22.27], translated by H. Rackham.

Two years later, in the archonship of Nicomedes, in consequence of the discovery of the mines at Maronea, the working of which had given the state a profit of a hundred talents, the advice was given by some persons that the money should be distributed among the people; but Themistocles prevented this, not saying what use he would make of the money, but recommending that it should be lent to the hundred richest Athenians, each receiving a talent, so that if they should spend it in a satisfactory manner, the state would have the advantage, but if they did not, the state should call in the money from the borrowers. On these terms the money was put at his disposal, and he used it to get a fleet of a hundred triremes built, each of the hundred borrowers having one ship built, and with these they fought the naval battle at Salamis against the barbarians. And it was during this period that Aresteides son of Lysimachus was ostracized.

Plutarch. [4.1–3], Themistocles, Bernadotte Perrin (ed.)

And so, in the first place, whereas the Athenians were wont to divide up among themselves the revenue coming from the silver mines at Laureium,

he, and he alone, dared to come before the people with a motion that this division be given up, and that with these moneys triremes be constructed for the war against Aegina [484-483]. This was the fiercest war then troubling Hellas, and the islanders controlled the sea, owing to the number of their ships.

Wherefore all the more easily did Themistocles carry his point, not by trying to terrify the citizens with dreadful pictures of Darius or the Persians—these were too far away and inspired no very serious fear of their coming, but by making opportune use of the bitter jealousy which they cherished toward Aegina in order to secure the armament he desired. The result was that with those moneys they built a hundred triremes, with which they actually fought at Salamis against Xerxes.

And after this, by luring the city on gradually and turning its progress toward the sea, urging that with their infantry they were no match even for their nearest neighbors, but that with the power they would get from their ships they could not only repel the Barbarians but also take the lead in Hellas, he made them, instead of “steadfast hoplites”—to quote Plato's words, [Plato, *Laws* 4.706] sea-tossed mariners, and brought down upon himself this accusation: “Themistocles robbed his fellow-citizens of spear and shield, and degraded the people of Athens to the rowing-pad and the oar.”